From Cold Fusion to Low Energy Nuclear Reactions: 2007 Update

Steven B. Krivit, Editor
New Energy Times

American Chemical Society, Chicago, IL

March 29, 2007

Cold Fusion - 1989 Perspective

- Mistake
- Fraud
- Incompetence, Delusion

This Was Correct …

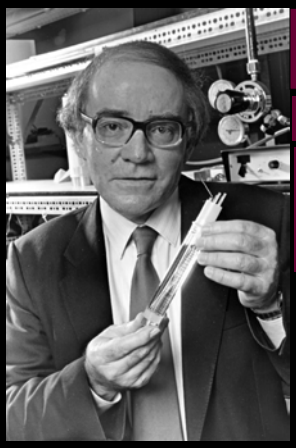
Based on …

1989 data, news and experts

18 Years in 20 Minutes?

http://newenergytimes.com/start

Cold Fusion Is Announced



Martin Fleischmann
University of Southampton

University of Utah
Press Conference

March 23, 1989

"… established a sustained nuclear fusion reaction … "

Stanley Pons
University of Utah

Major Problems !

1. Poor repeatability
2. No replications
3. Poor corroborative nuclear evidence
4. Error with gamma / neutron data
5. Poor communication with their peers
6. Press conference for patent priority
7. Appeared to contradict laws of physics

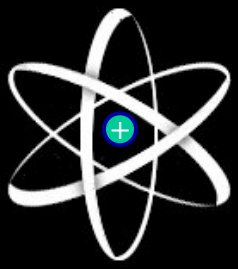
18 Years Later …

1. High repeatability
2. SPAWAR co-deposition - narrow replications
3. Excess heat and transmutations - broad replications
4. Expansive corroborative nuclear evidence
5. Proposed Widom-Larsen theory

Conventional Fusion

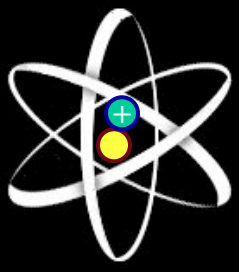
- Joining of atomic nuclei
- Energy research since 1951
- 0 Watts usable power
- Projection: 50 more years for energy

Deuterium - Fusion's Fuel



Normal Hydrogen
(one proton)

Deuterium (Hydrogen isotope)
(one proton, one neutron)



Hydrogen Energy Release

H

Chemical Reaction

H (D)

Nuclear Fusion Reaction

LENR – The Last 18 Years

- 55 peer-reviewed journals
- 12 International Conferences
- 28 Regional Conferences
- 6 Recent books [Storms (in press), Kozima, Krivit/Winocur, Beaudette, Mizuno, Vysotskii/Kornilova]
- 200 researchers
- 13 nations

Cold Fusion? Maybe, but …

Could be fusion …

Could be something else …

Either way – potentially significant

Condensed Matter Nuclear Science

Major Effects

- Mossbauer Effect
- **Low Energy Nuclear Reactions**
- Nuclear Magnetic Resonance
- Magnetic Resonance Imaging

Minor Effects

- Hyperfine Structure in Optical Spectra
- Isotope Shifts in X-Ray Spectra

Note: This listing is indicative and not complete

David J. Nagel, The George Washington University, October 2006

Low Energy Nuclear Reactions (LENR)

- **COLD FUSION** → Heat and Helium-4
- **NUCLEAR REACTIONS** → Heavy Element Transmutation

"Low" Is A Relative Term.
DoE has a Low Energy Nuclear Physics Program

David J. Nagel, The George Washington University, October 2006

Threshold Parameters for the Excess Heat Reaction

(McKubre - SRI International)

1. Minimum Atomic Ratio D:Pd (> 0.90)
2. Minimum Current Density (250 mA/cm$^{2)}$
3. Dynamic Trigger

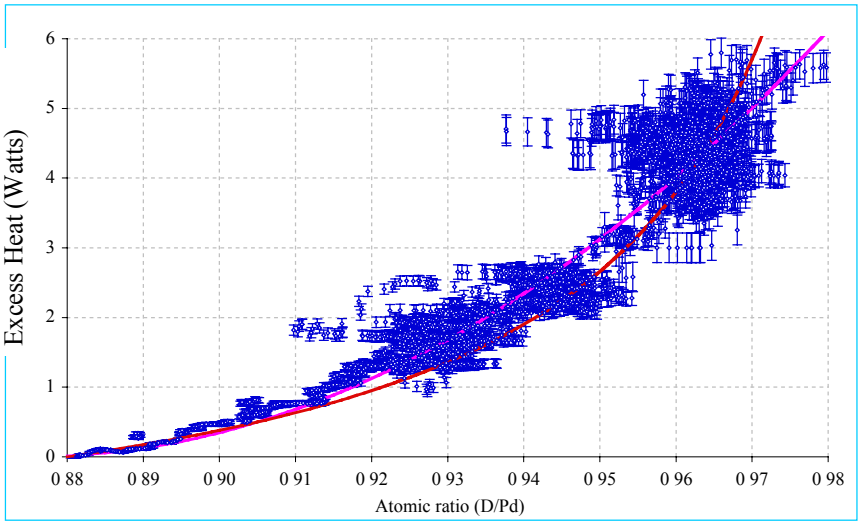
It's a Materials Science Problem!

Letts-Cravens Laser - Surface Plasmon Effect

Excess Heat vs. Loading Ratio

(Qualitative Analysis)

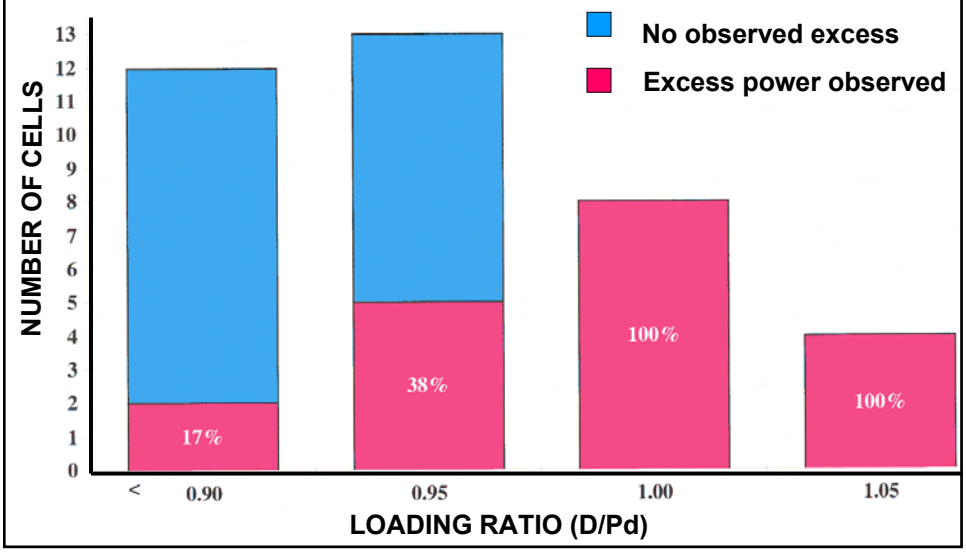
(McKubre - SRI International)



Cells Showing Excess Heat vs. Loading Ratio

(Quantitative Analysis)

(McKubre - SRI International)



Many Methods Claimed

For example:

- Electrolysis (3 methods)
- Gas (2 methods)
- Cavitation (3 methods)

Nuclear Ash

Products/Effects	D/Pd	H/Pd
Heat	10^{12} events/s/W	Minor
Helium-4	10^{11} events/s/W	n/a
Tritium *	10^{4} events/s	
(Fast? Slow?) Neutrons	Uncertain	Uncertain
Charged Particles	Yes	
Heavy Element Transmutation	Minor	Major
Gamma-Rays	Yes	
X-Rays	Yes	
Hot Spots on Cathodes	Yes	
Craters, Melting, Vaporization	Yes	

Selected Excess Heat Claims

Ref	Name	Year	Max.Excess Heat	% Excess Heat	Time	Excess Energy
1	Arata	1999	10w	No data	2000h	No data
2	El-Boher #56	2004	3.5w	80%	300h	3.1Mj
2	**El-Boher #64a**	**2004**	**34w**	**2500%**	**17h**	**1.1Mj**
2	**El-Boher #64b**	**2004**	**32w**	**1500%**	**80h**	**4.6Mj**
3	Stringham	2004	40w	No Data	No Data	No Data
4	Takahashi	1992	130w	70%	1440h	No Data

See appendix E for references

Fleischmann-Pons Excess Heat Claims

Never Disproved!

“The Seminal Papers of Cold Fusion”

Q. So What is LENR, Anyway?

A1. Nobody really knows.

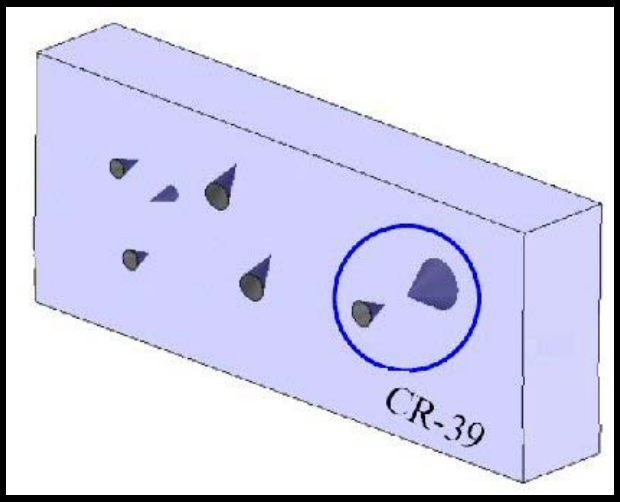
A2. “The experimental and theoretical study of reactions with hydrogen and deuterium in the presence of a metal.”

SPAWAR San Diego Co-Deposition Experiment

Szpak, Mosier-Boss, Gordon, Forsley

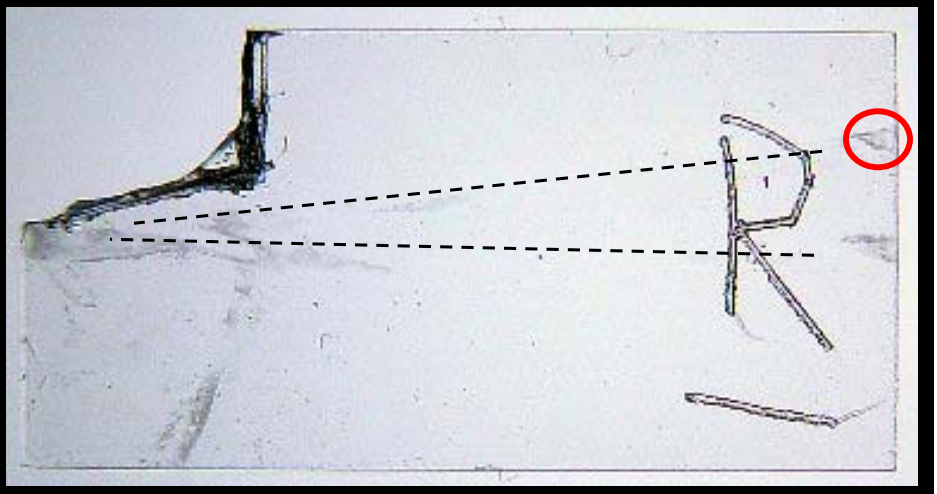
1. ***Repeatable and reproducible***
2. ***CR-39 detectors - Simple, portable, permanent***
3. ***Signal to noise - up to 1,000:1***

CR-39 Particle Track Detector

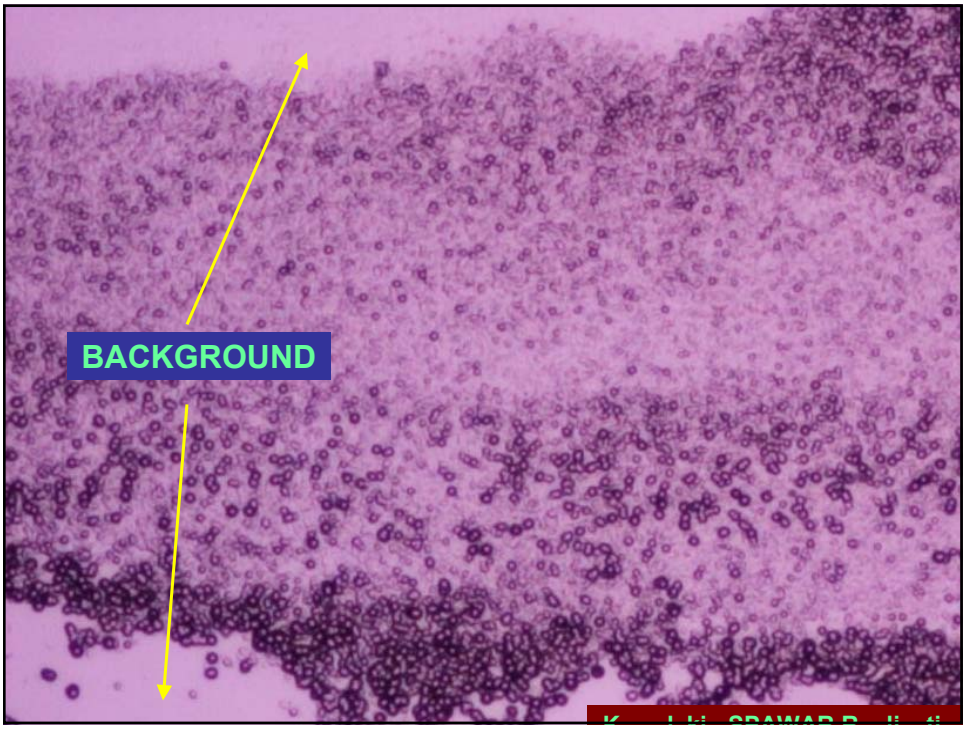


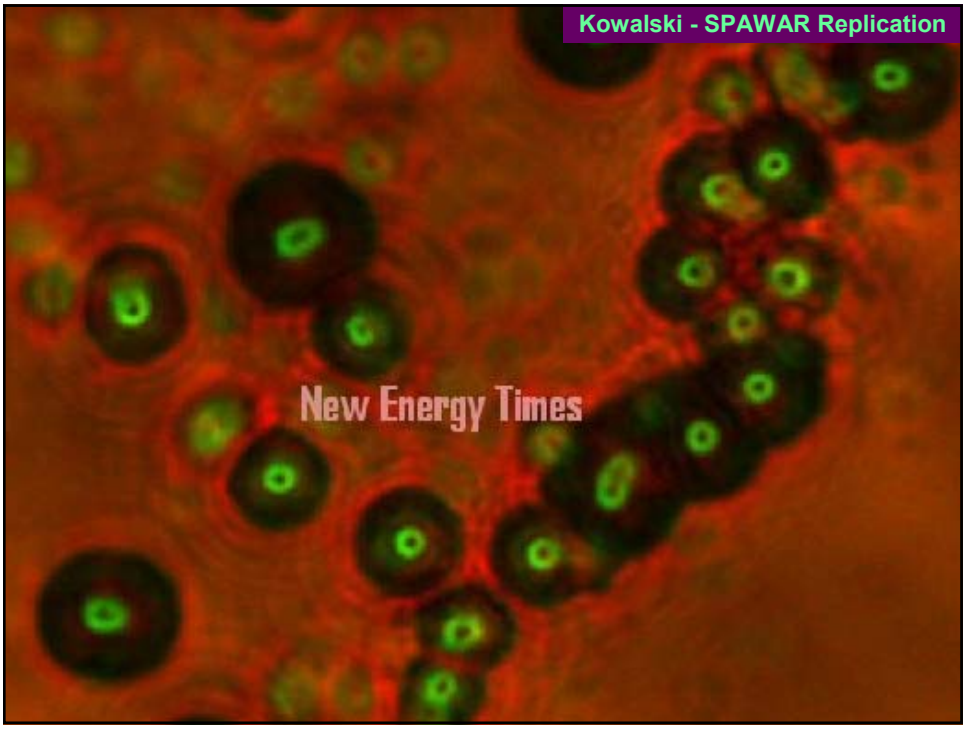
Modified from original diagram by Michael J. Canavan of MIT

CR-39 Particle Track Detector



Kowalski - SPAWAR Replication

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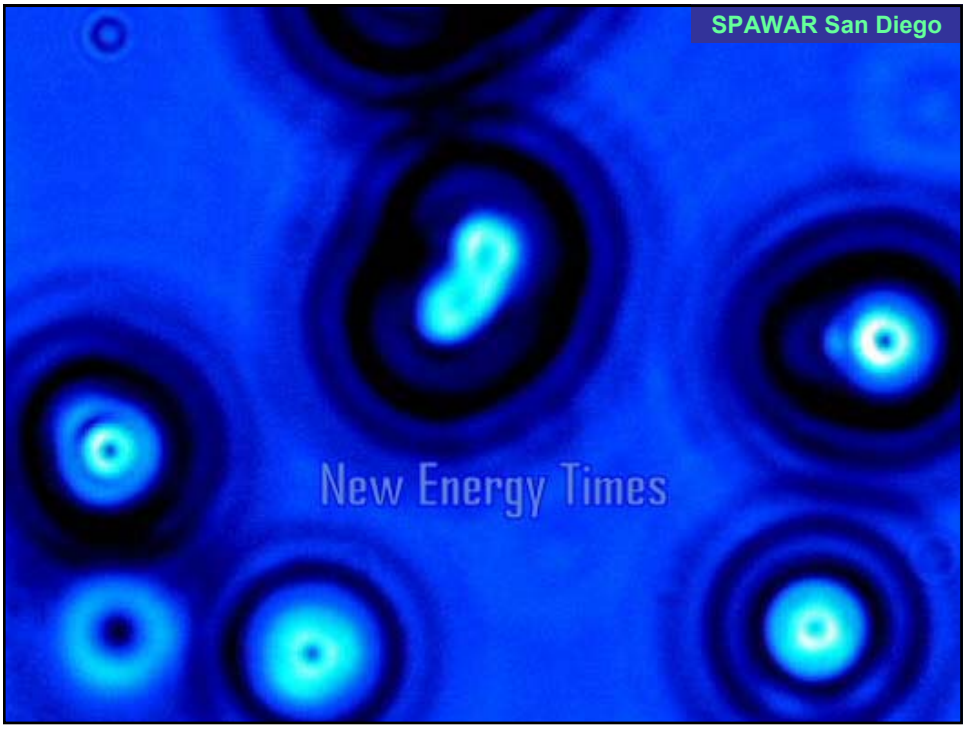
New Energy Times


SPAWAR San Diego
New Energy Times

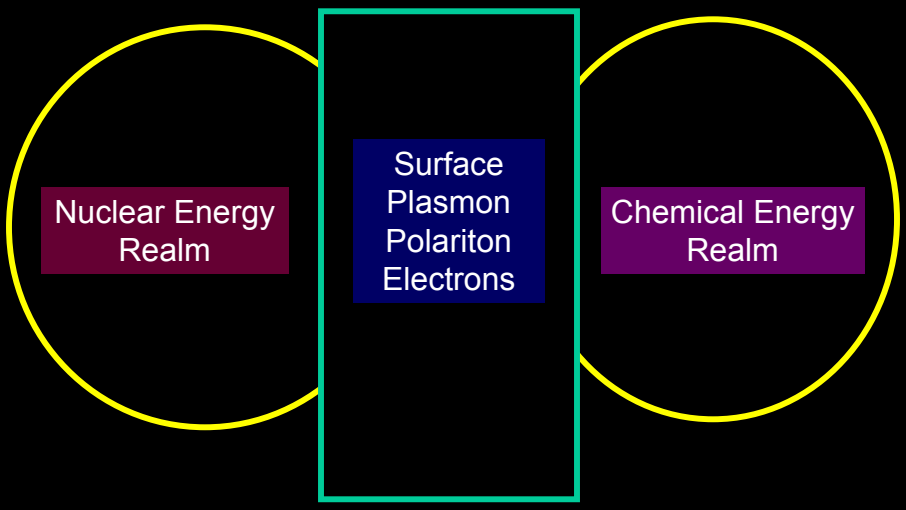
SPAWAR Co-Deposition Key Points

1. **Penetration of 1mm thick plastic**
2. **“Dry” as well as “wet” geometries**
3. **Tracks on front and back of CR-39 – both sets spatially correlated to cathode**
4. **Energy calculations under way**

Widom-Larsen Theory Highlights of Claims:

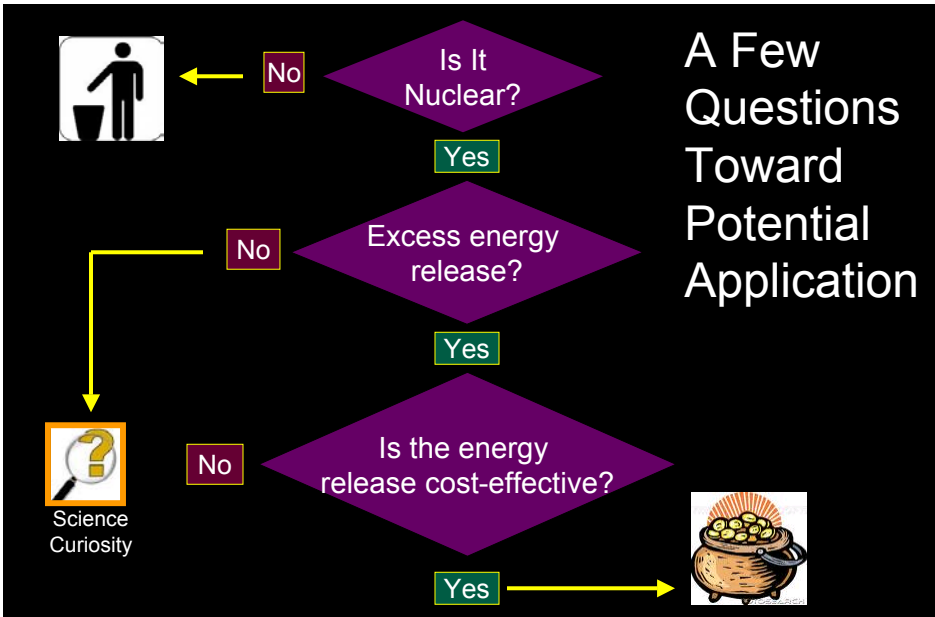
1. Not fusion/fission; weak interactions
2. Explains most anomalous experimental data in "cold fusion"
3. Matches Miley transmutation data
4. Explains light and heavy hydrogen experiments
5. No “new physics”

Widom-Larsen Theory



Widom-Larsen Theory

www.newenergytimes.com/wltheory



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